# Gravel Road Maintenance Workshop

**Jason M. Dietz**
*Pavement and Materials Engineer*

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Federal Highway Administration
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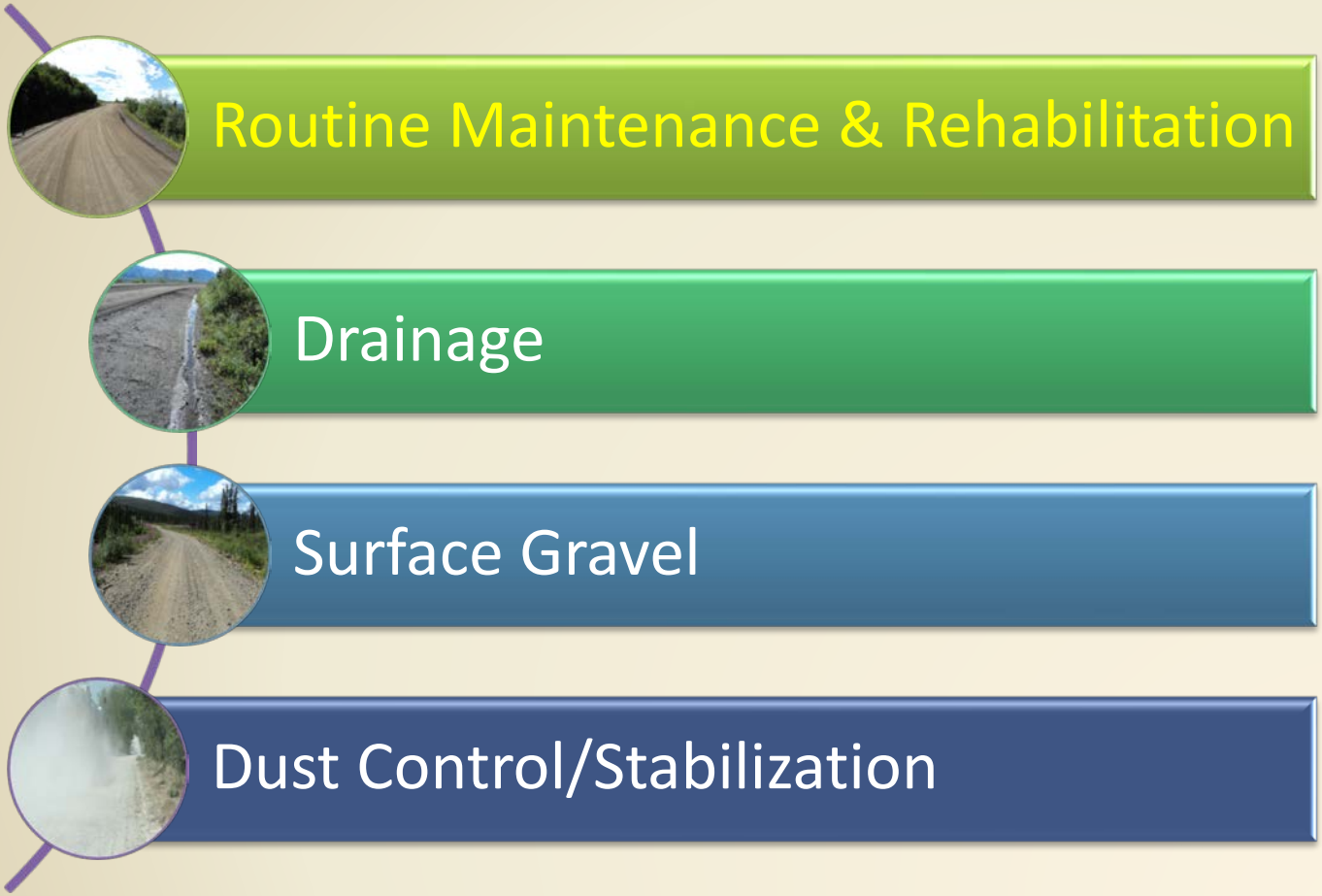
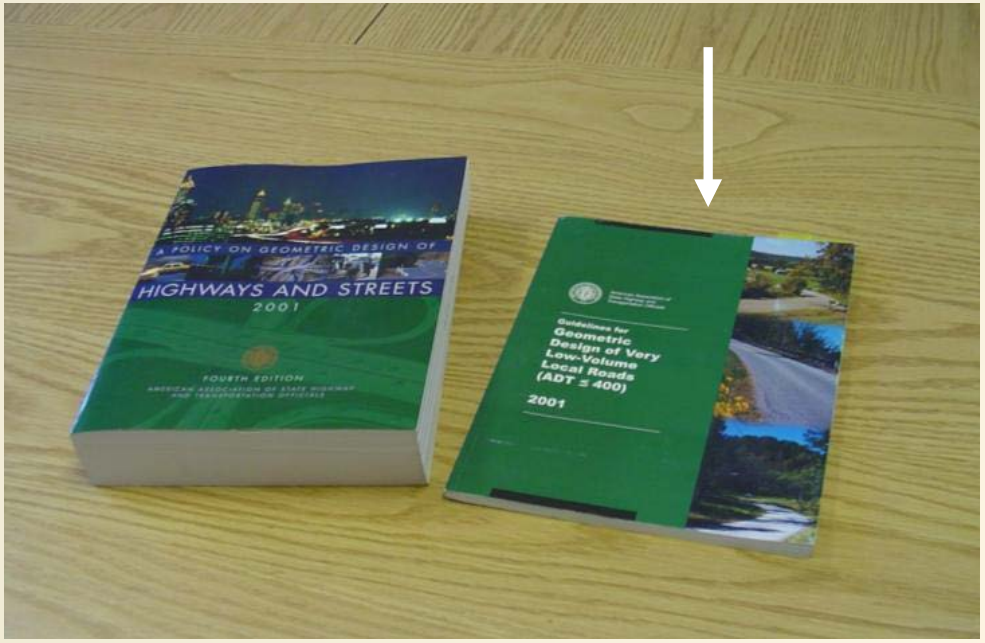
# Key Topics of Discussion



# Design Issue – Basic Geometrics

- Be familiar with the AASHTO publication: Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)
- Commonly called the "Little Green Book"

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# Design Issue – Basic Geometrics

- "Nearly 80% of the roads in the US have traffic volumes of 400 vehicles per day or less." (quote from Little Green Book)
- It becomes very difficult to construct and maintain these very low-volume roads to a high geometric standard.

# AASHTO Guidelines

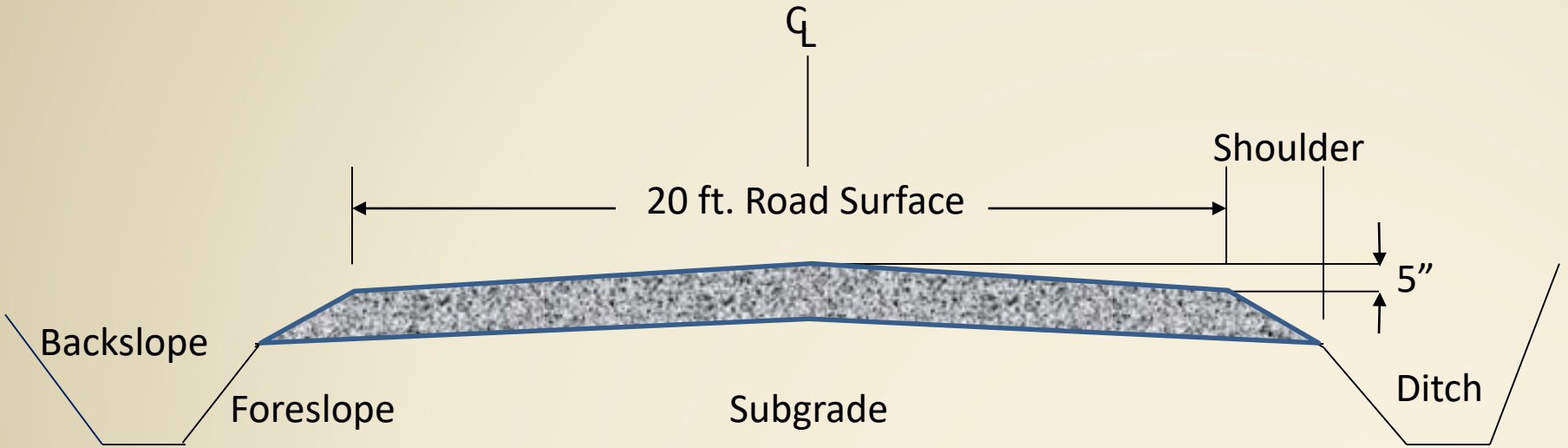
| Design Speed (km/h) | Major Access | Minor Access | Recreational & Scenic | Industrial/ Commercial Access | Resource Recovery | Agricultural Access |
|---|---|---|---|---|---|---|
| 15 | --- | 18.0 | 18.0 | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 40 | .0 | 18.0 | 20.0 | 22.5 | --- | 24.0 |
| 45 | 20.0 | 20.0 | 20.0 | 23.0 | --- | 26.0 |
| 50 | 20.0 | 20.0 | 20.0 | 24.5 | --- | --- |
| 55 | 22.0 | --- | 22.0 | --- | --- | --- |
| 60 | 22.0 | --- | --- | --- | --- | --- |

Note: Total roadway width includes the width of both traveled way and shoulders.

Lowest guideline: Major access requiring roadway width of 20 ft. at design speed of 45 mph

Highest guideline: Agricultural access requiring roadway width of 26 ft. at design speed of 45 mph

# Roadway Cross Section




**Generally recommended crown for gravel surfaces is 4% (1/2 in. of crown per foot) which is double the crown used in pavements.**

# Crown (contd.)

Clear illustration of 2% crown on the road to the left and 4% on the road to the right. Water will not drain off an aggregate surface with only 2% crown. This must be addressed in design and during construction.

Some roads have too little crown, some have too much.

# Crown Gauges Are Helpful


# Crown (contd.)

There are conflicting views on crown:

- 1/3 to ½ in. per ft.. recommended by NACE manual Blading Aggregate Surfaces – 1986 edition.
- 2 to 6% for “low-type pavements” recommended by AASHTO Green Book pg. 387, 2001 edition.
- 4% by FHWA Gravel Roads Manual

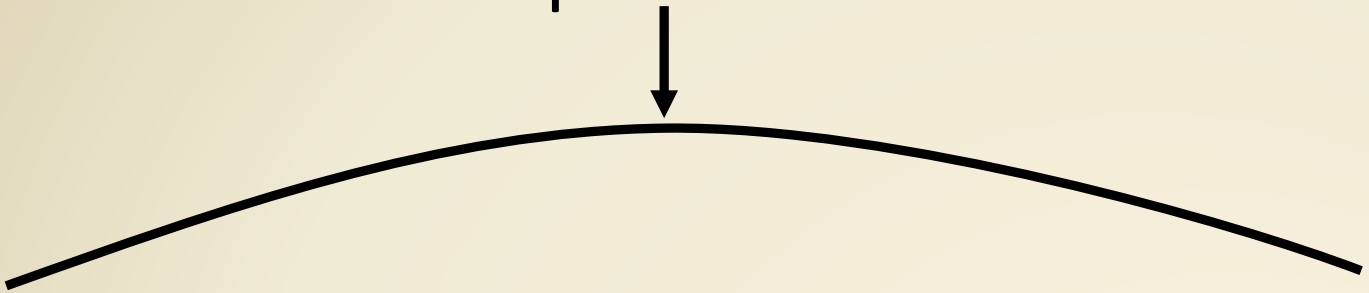
**Note: In arid and semi-arid regions, gravel roads may perform with less crown, but don’t use less than 3%.**

# Maintaining Roadway Shape

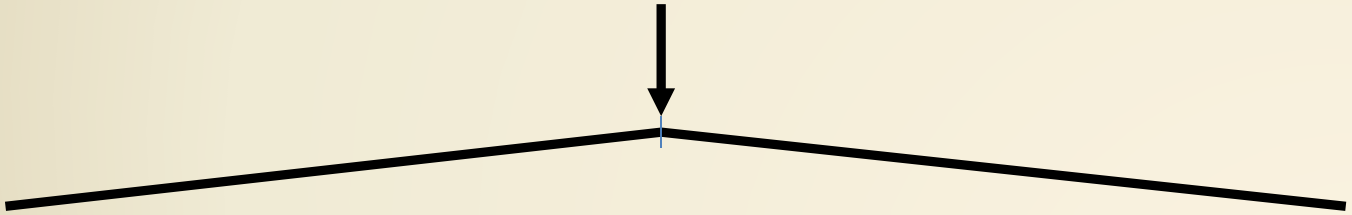
- Perhaps the most critical issue is keeping cutting edges straight.
- Many operators do not understand the importance of this and/or do not know how to control it.

# Center Wear In The Cutting Edge

Creates a parabolic crown.



Instead of correct shape.



# Once road develop parabolic shape, it becomes hard to change.

This center wear occurred after only six hours of use on badly shaped road.

# Reducing Center Wear In The Cutting Edge

Potential solutions: carbide cutting edges or bits.

# Gravel Roads – Managing Maintenance

## Frequency of blade maintenance:

- Should be managed by observing surface conditions, not just by calendar date.
- Don’t delay blade maintenance until surface distress becomes severe.
- In areas of high moisture, vegetation will creep
- A good program of shoulder mowing is essential to gravel road maintenance.

# Dealing with High Shoulders

The high shoulder which obstructs drainage – is a real problem on too many roads.

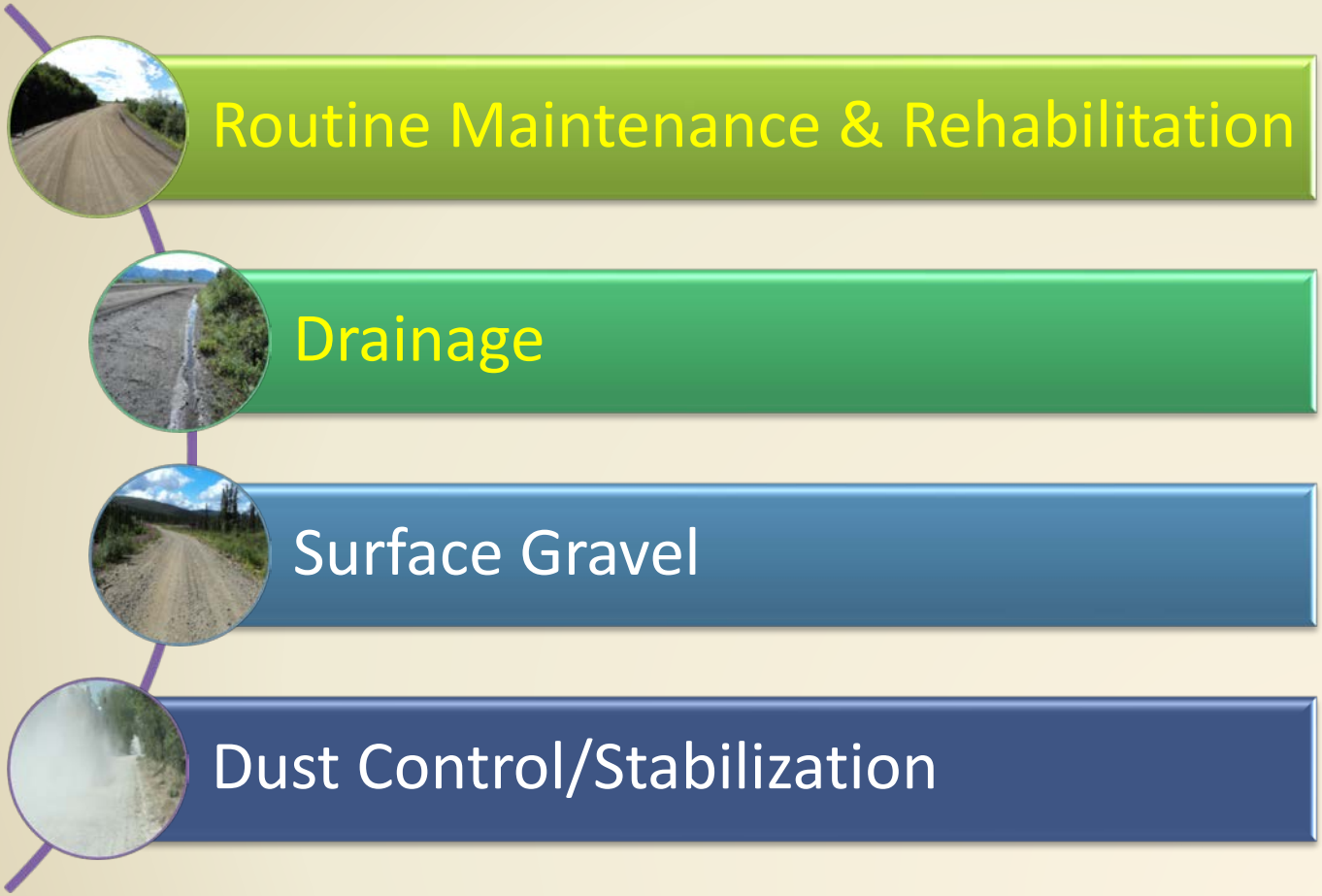
# Problem Created By Higher Shoulder

# Outstanding Example

How about this shoulder drainage?

# Outstanding Example In Confined ROW

# Key Topics of Discussion



# Drainage

- Basic drainage topics: ditches, culverts and bridges, and underdrains.

# What’s wrong here?

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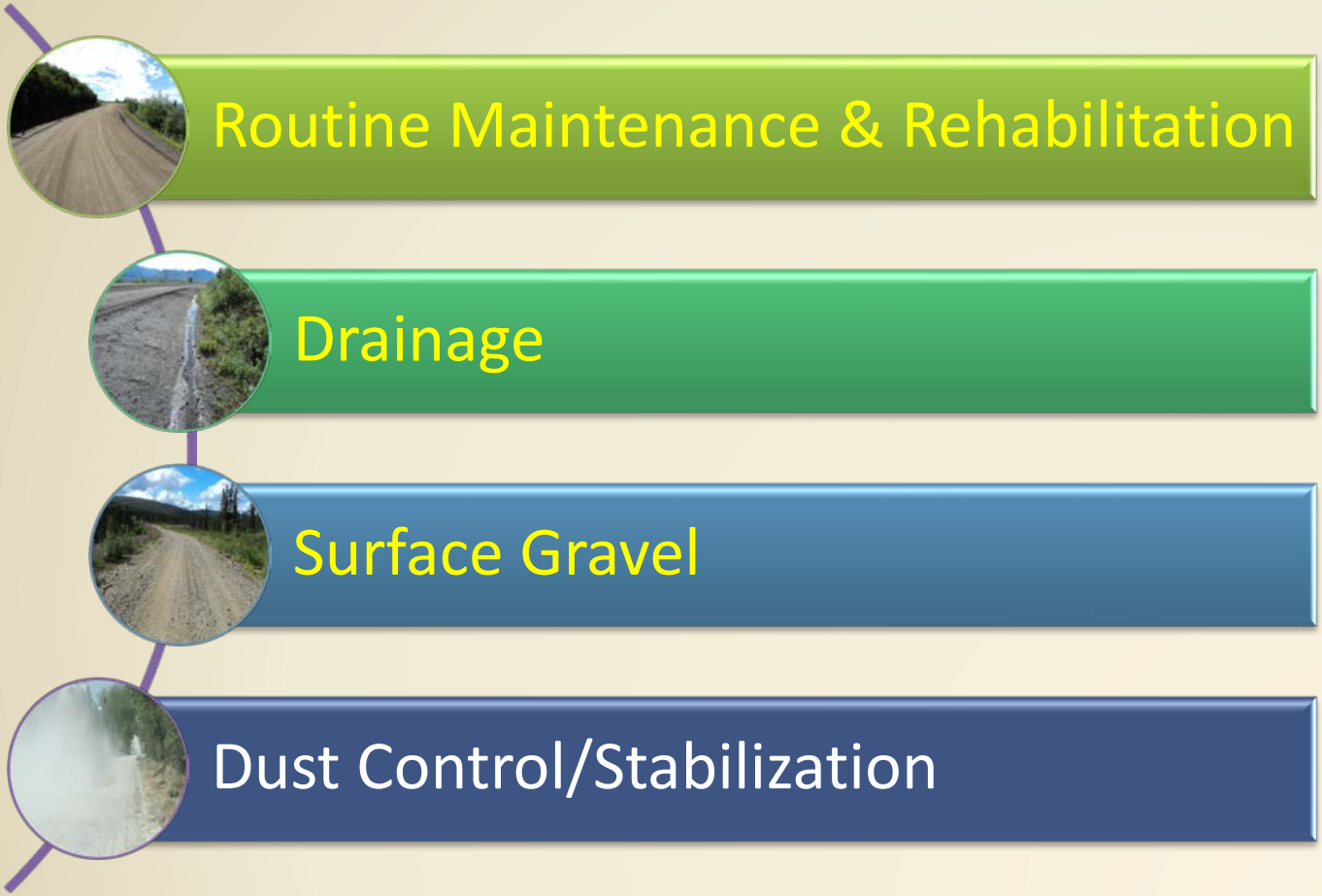
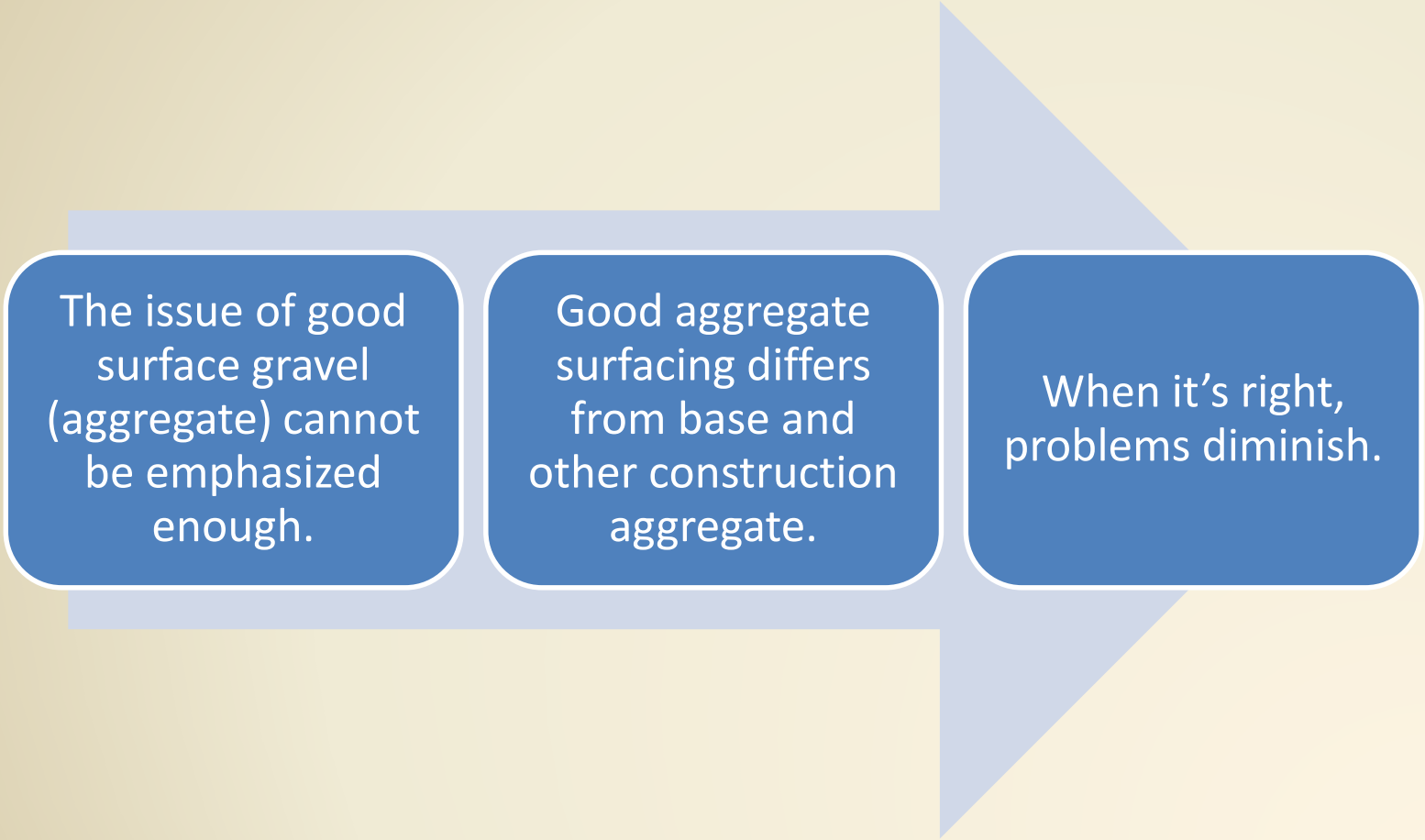
# Key Topics of Discussion



# Management Issue – Surface Gravel



# Material Specifications Discussion

- Many state DOTs do not have a surface aggregate specification
- Many specifications that do exist are quite loose and do not allow close enough control of gradation.
- Too often, surface aggregate is perceived as not important, hence quality suffers.
- Study completed in Canada (2003) – Samples were taken from several stockpiles being marketed as surface aggregate---contd. next slide

# Material Specifications Discussion

- Only 14% of the samples met the companies own specifications when tested by independent labs.  Quality control was almost nonexistent.

Information came from *Materials and Performance Specifications for Wearing Course Aggregate on Forest Roads* by G. Legere & S. Mercier.

# Surface Gravel (contd.)

Surface aggregate differs from base aggregate in two fundamental ways:

- The need for more plastic fines to serve as binder, and
- Smaller top-sized stone that will remain embedded in the surface.

# Surface Gravel (contd.)

Similar ADT, similar geometrics, but different surface materials.

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# Surface Gravel (contd.)

Corrugation or "washboarding" which is surface distress that is directly related to surface aggregate specification.

# Surface Gravel (contd.)

Sample specification comparison:

| Requirement Sieve | Aggregate Base Course Percent Passing | Gravel Surfacing Percent Passing |
|---|---|---|
| 1” | 100 | |
| 3/4 ” | 80 – 100 | 100 |
| 1/2 “ | 68 – 91 | |
| No. 4 | 46 – 70 | 50 – 78 |
| No. 8 | 34 – 54 | 37 – 67 |
| No. 40 | 13 – 35 | 13 – 35 |
| No. 200 | 3 – 12 | 4 – 15 |
| Plasticity Index | 0 - 6 | 4 - 12 |

Better when modified to 8 -15

From South Dakota Standard Specifications

# Surface Gravel (contd.)

Sample specification comparison:

| Gradation No. 3 | | |
|---|---|---|
| Sieve Size | Crushed Gravel | Crushed Stone |
| 1” | 100 | 100 |
| 3/4 “ | 95 - 100 | 95 - 100 |
| 3/8 “ | 50 - 90 | 50 - 90 |
| No. 4 | 35 - 70 | 35 – 70 |
| No. 10 | 20 - 55 | 15 - 55 |
| No. 40 | 10 - 35 | --- |
| No. 200 | 9 - 15 | 5 - 15 |

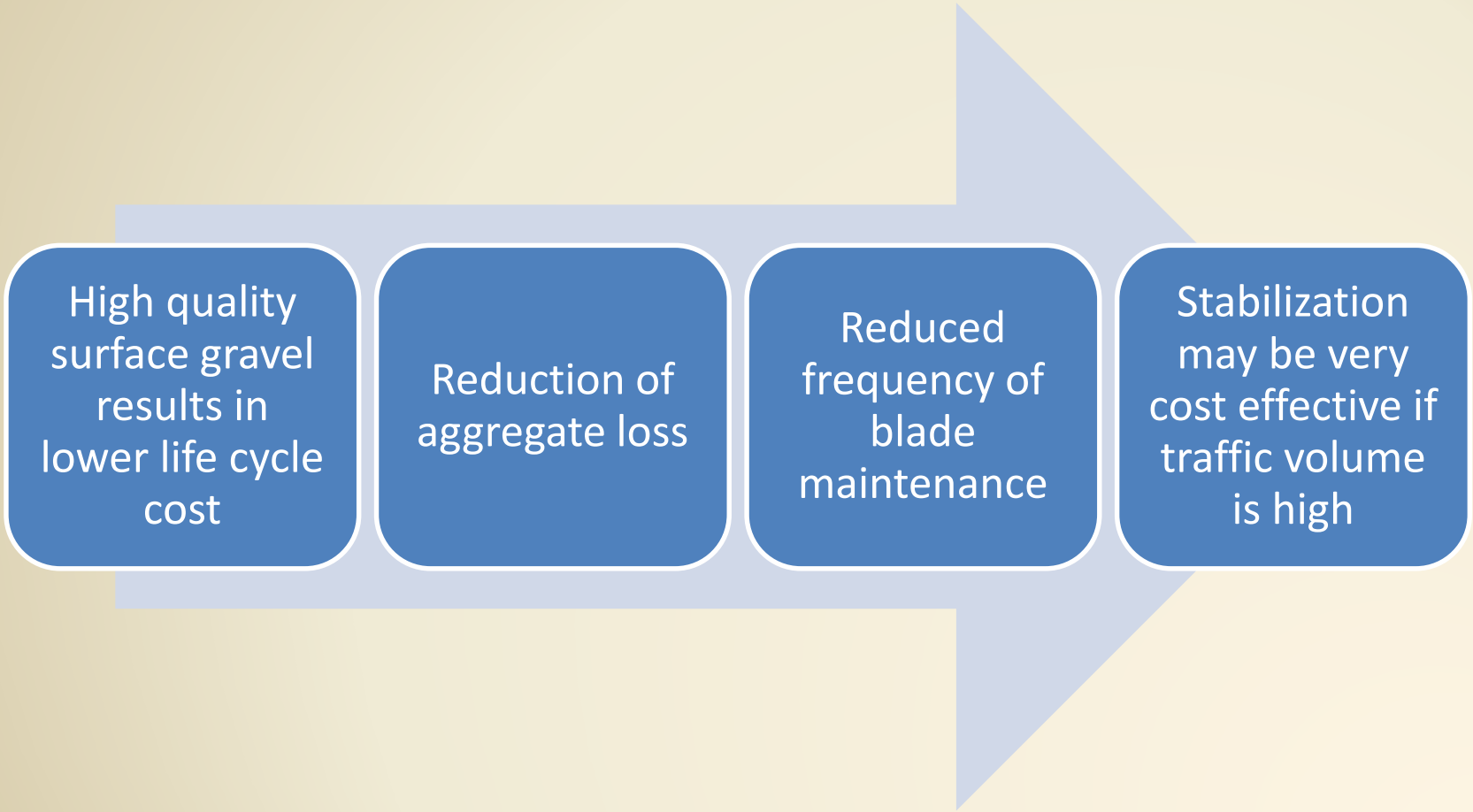
WisDOT Crushed Aggregate Shoulder Course

# Surface Gravel (contd.)

AASHTO's Materials Manual – 2001 Edition, Designation M-147 references the following:

*Where it is planned that the soil aggregate surface course is to be maintained for several years without bituminous surface treatment…, the engineer should specific a* ***minimum of 8% passing…No. 200 sieve****…, and should specify a maximum* ***liquid limit of 35*** *and* ***plasticity index range of 4 to 9*** *in lieu of the limits given in Section 2.2.2.*

# Preservation of Gravel – Conserving A Precious Resource



# Aggressive Shoulder Maintenance

Innovative tools to help reshape the high shoulder and recover gravel.

# Key Topics of Discussion

# How can we control this?

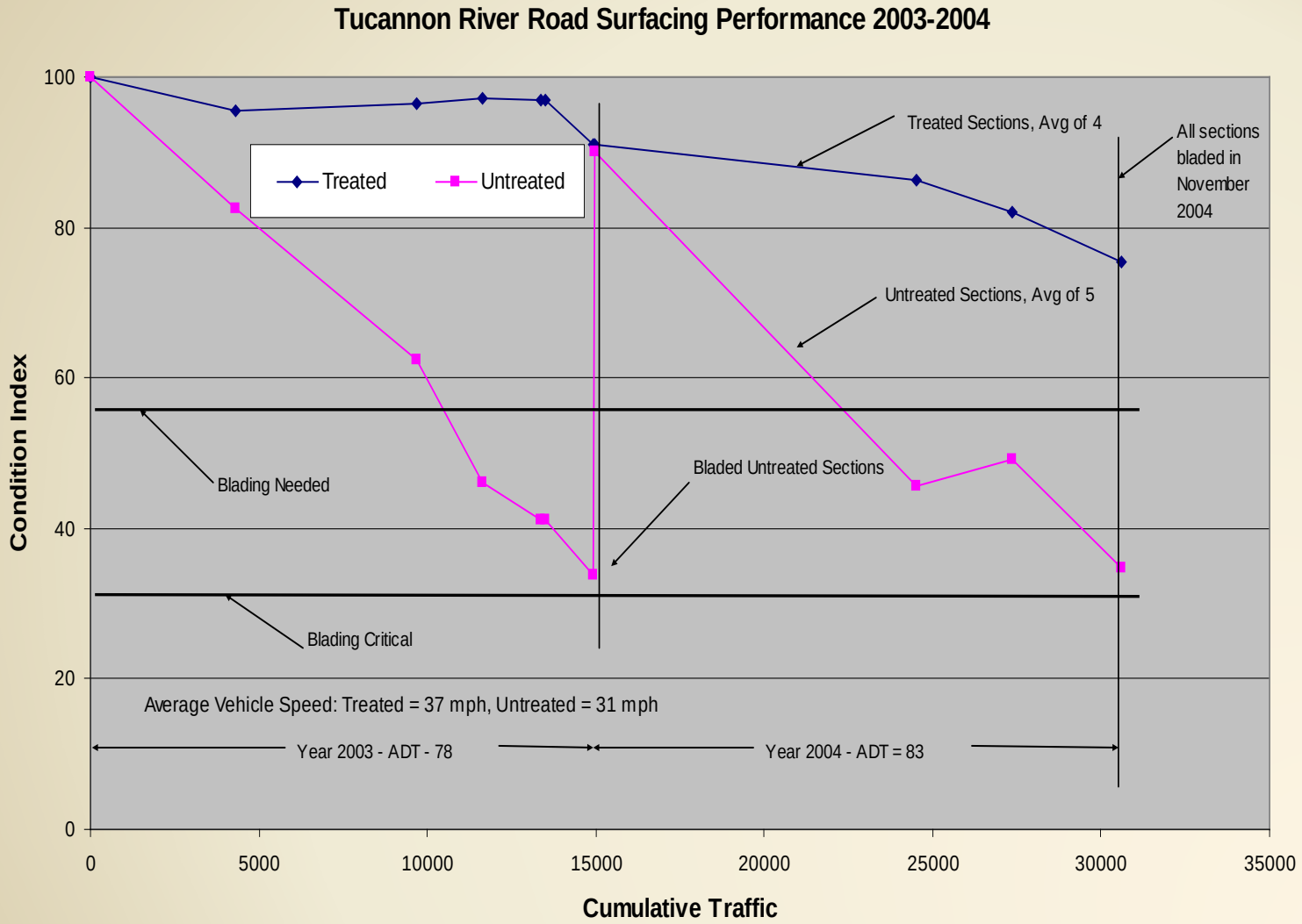
# Dust Abatement & Stabilizing Products

- Survey completed in 2014 nearly 200 named products are being marketed.
- Common types
  - Chlorides (most commonly used)
  - Resins
  - Natural Clays
  - Petroleum Oils
  - Portland Cement

# Calcium Chloride

- A salt that draws moisture from the air
- Liquid or Solid
- Liquid has lower concentration rate (<40%)
- Solid has higher concentration rates (>90%)

# Benefits




Data from USFS Study

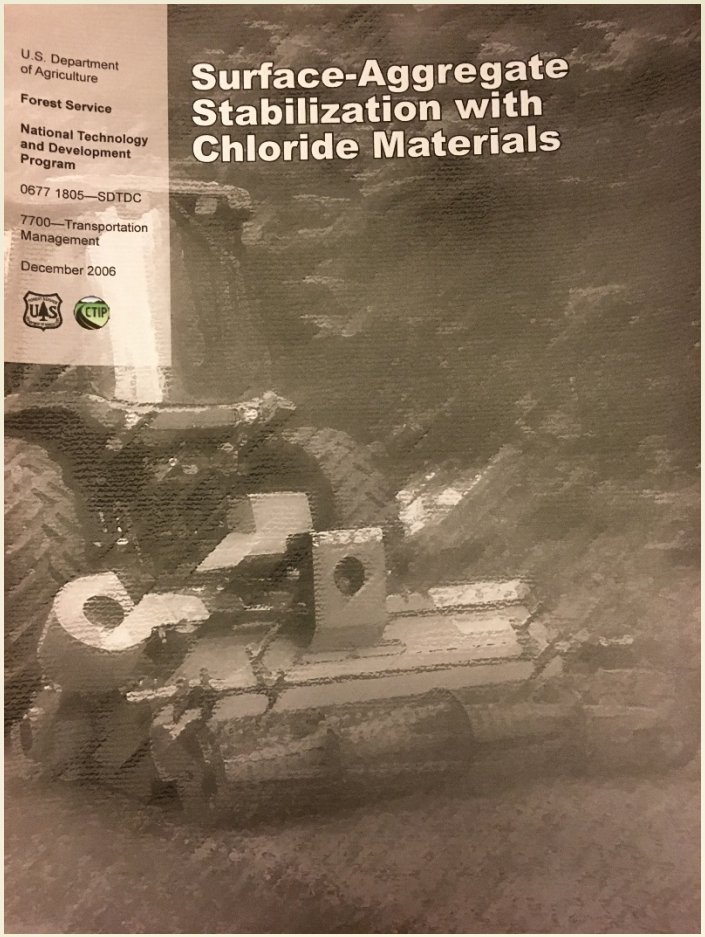
# Use on Projects

- Test Sections – 2008 & 2009
- Trial Contract - **2009**
- Implementation – 2010 & 2011
- Expanded Use – 2012 and 2014



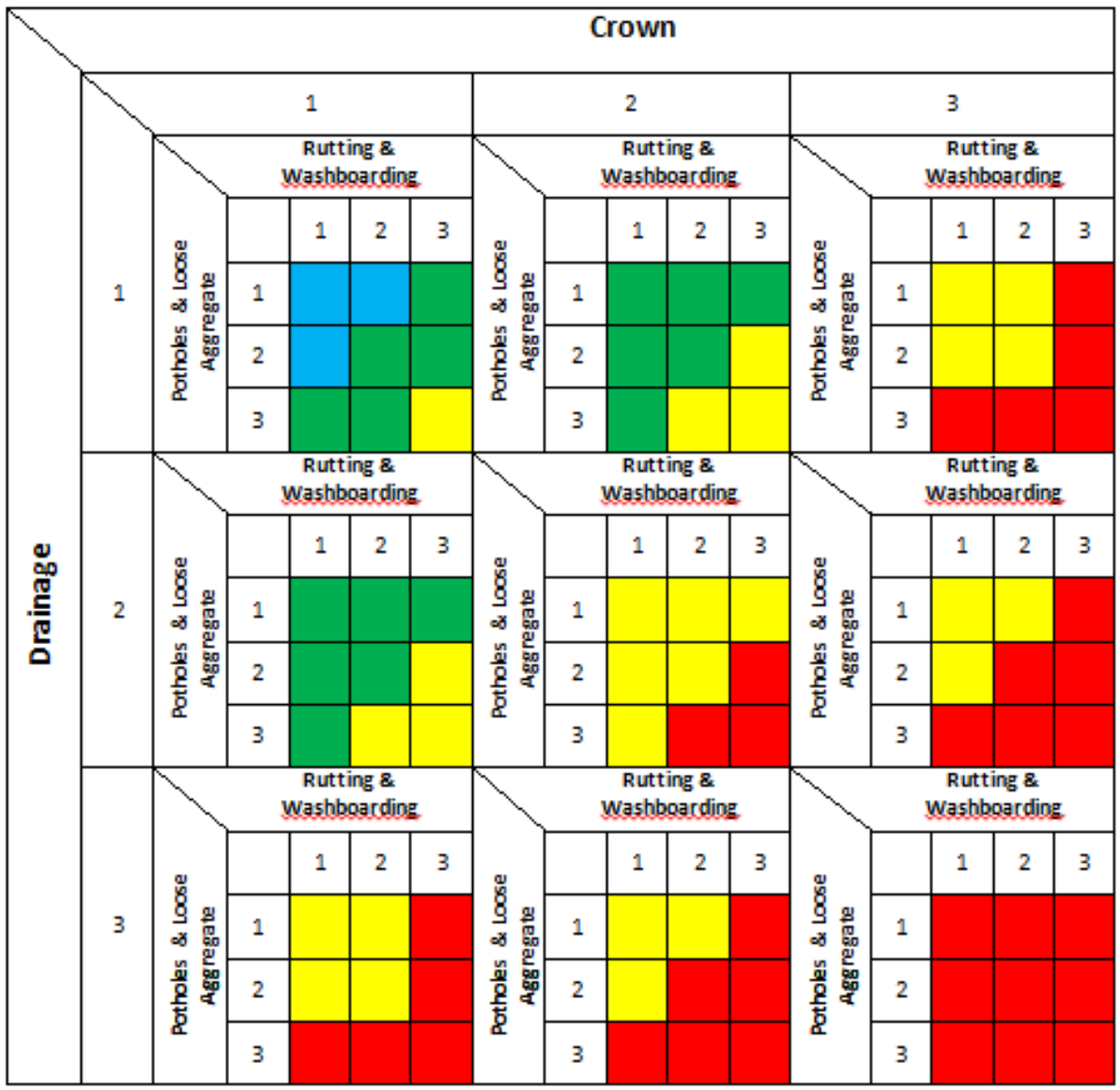
# Implementation

# References




https://www.fs.fed.us/eng/pubs/pdf/06771805.pdf

# Prioritization and Optimization




Limited/Local Maintenance

Routine Maintenance (RM)

Heavy Preventive Maintenance/ Light Rehabilitation (HPM/LR)

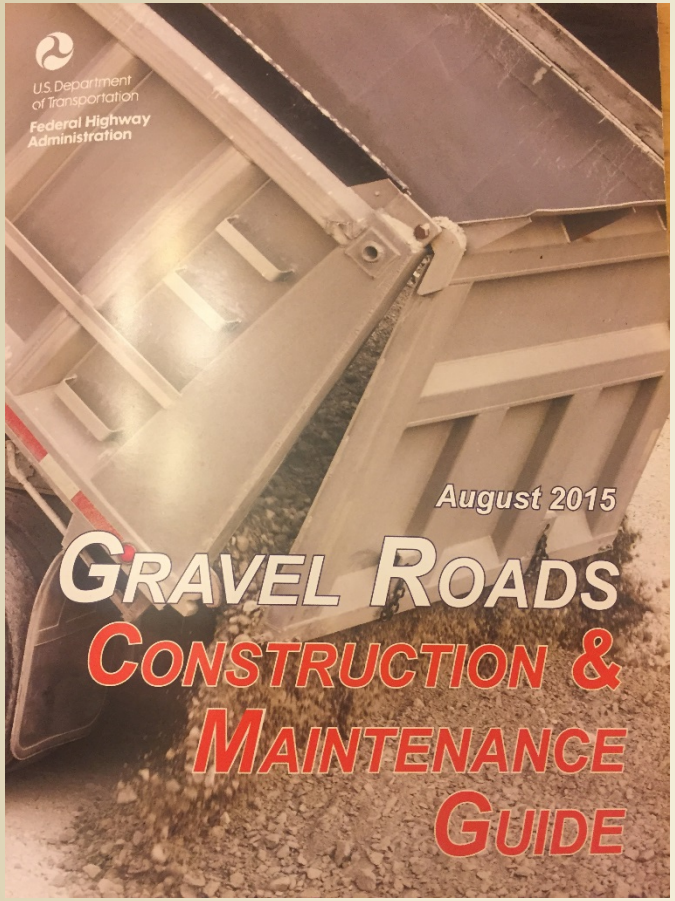
Heavy Rehabilitation (HR)

| Road Type | Costs* | RM | HPM/LR | HR |
|---|---|---|---|---|
| Gravel | Per mile | $3,000 | $40,000 | $100,000 |
| | Per Sq. yd. | $0.23 | $3.00 | $8.00 |
| Native | Per mile | $2,000 | $10,000 | $40,000 |
| | Per Sq. yd. | $0.15 | $0.77 | $3.00 |

* Costs based on nationwide averages. Regional cost factors should be applied

Stantec

# References




https://www.fhwa.dot.gov/construction/pubs/ots15002.pdf

# What questions do you have?

# Thank you!
# For Questions/Comments:

U.S. Department of Transportation
**Federal Highway Administration**


The Office of Technical Services
- *FHWA Resource Center*
- *National Highway Institute*
- *Technology Partnership Programs*

**Jason M. Dietz**
Pavement and Materials Engineer

FHWA Resource Center
720-810-0871
**Jason.Dietz@dot.gov**
www.fhwa.dot.gov/resourcecenter